



Working under NASA contract in cooperation with the Florida Solar Energy Center (FSEC), Dinh Company, Alachua, Florida has developed a prototype heat pipe dehumidification system that can double the moisture removal capacity of any air conditioner and save substantial amounts of energy. This marks a major step in a NASA application engineering program intended to apply space-developed technology to control of humidity in building environments. Moisture removal remains a persistent problem in warm, humid climates, not only with respect to personal comfort but also in providing adequate dehumidification for proper storage and functioning of costly equipment. Heat pipe technology developed for temperature control of space electronic systems offers a promising approach to cost-effective dehumidification.

The idea of a heat pipe-based dehumidifier originated with Khanh Dinh, who at one time was associated with NASA's Southern Technology Applications Center (STAC), where he conducted research on gravity heat pipes. In 1981, Dinh visited FSEC and learned of a problem that FSEC was

then investigating: the high energy losses incurred in extracting excess moisture from superinsulated buildings in very humid climates. In a moderately humid climate, a typical room air conditioner cools air and lowers humidity with normal cooling coil operation. In a highly humid environment, however, the same air conditioner will only partially reduce humidity, leaving uncomfortably humid room air. To lower the humidity to an acceptable level, the air conditioner must operate longer and use more energy. Then, in the process of lowering humidity, it overcools the room air; that necessitates reheating the air to get it back to a comfortable temperature—and that takes additional energy.

On the basis of his NASA/STAC experience, Dinh submitted a proposal to FSEC for an advanced energy saving dehumidifier fitted with three banks of heat pipes. FSEC accepted the proposal and had Dinh build an experimental air conditioner/dehumidifier, which was successfully tested. It attracted the attention of Kennedy Space Center's Tech-

nology Utilization Office, which awarded FSEC a contract to study the feasibility of the heat pipe-based dehumidifier. The following year, the newly-formed Dinh Company received a NASA contract for further development of the dehumidification system.

In the Dinh system, the heat pipes are used to precool the air before it reaches the cooling coil of an air conditioner. The cooling coil removes additional heat and humidity, then the heat pipes restore the overcooled air to a comfortable temperature. In other words, the cooling coil operates for a normal period of time regardless of humidity conditions and leaves the job of reheating to the passive heat pipes, which use no energy. With dryer air, the same comfort level can be attained with higher thermostat settings. Thus, the Dinh system offers typical energy savings of 15 to 20 percent.

The heat pipe is undergoing test at several sites in Florida, one of them the home pictured at left; the Dinh unit is the blue box nearest the garage door adjacent to the hot water tank (white cylinder); visible on the roof are the solar panels that provide electric-



ity for the heat pipe system. In another Florida home, Dinh Company has installed a retrofit cooling coil, known as the "Z" coil, on an existing standard heater/air conditioner (above); the Z coil, which replaces the regular A coil evaporator, increases moisture removal by almost 100 percent. Khanh Dinh (at right in photo) is explaining the bonus benefit of a heat recovery unit, included in this installation, that takes heat removed by the Z coil during the dehumidification process and uses it to provide free hot water. The upper right photo shows the various

components of the heat pipe dehumidifier. At lower right are a number of production units in various stages of completion; in the foreground, a company employee is performing a quality control check on the Z coil.

In 1985, Kennedy Space Center and the NASA Application Team instituted a three-year extension of the heat pipe technology program that involves further development and commercialization of the Dinh dehumidifier, optimization



of dehumidifiers and heat pipes by FSEC, and support from Carrier Corporation for large-scale implementation of the heat pipe-based dehumidifier and comparison of its effectiveness with conventional approaches. NASA is sharing the funding and serving as technical monitor for the program.

Formed in October 1983, the Dinh Company is engaged in several areas of development related to heat transfer and solar power. In addition to the dehumidifier, the company has developed a photovoltaic (solar cell-powered) air conditioner and a highly efficient



solar-powered water pump. It is also planning development of a solar dish concentrator that combines photovoltaic and heat pipe technology in an attempt to make a dramatic reduction in the cost of solar electricity. ▲